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ABSTRACT

Data from the 1990 National Assessment of Educational Progress (NAEP) Trial State Assessment (TSA) in mathematics were analyzed to determine what educational factors influence student learning, how these factors influence learning, and how important these factors are to student achievement. NAEP TSA data were collected from more than 100,000 eighth-grade students in approximately 100 schools in each of the 37 participating states. The database for the study consisted of information on teachers, administrators, and students from 3,351 schools. A modified version of the model of J. A. Centra and D. A. Potter was used to identify paths among important educational constructs using path analysis and the 1990 NAEP TSA data. Paths among characteristics of students, school conditions, and teachers; paths to behaviors of students and teachers; and paths to achievement were identified. Results confirm that student characteristics and student behavior have large impacts on student achievement. Findings further suggest that educators can influence student behavior through teacher behavior and school conditions. Efforts to improve education should focus on things the school can control through school policies and teaching strategies. Teacher content knowledge and academic emphasis are important factors through which schools can make a difference in student achievement. Eleven figures illustrate the discussion. (Contains 35 references.) (SLD)

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Factors Affecting Student Learning Outcomes: A School-Level Analysis of the 1990 NAEP Mathematics Trial State Assessment

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Introduction

It has been almost three decades since the Equality of Educational Opportunity (EEO) study (Coleman, Campbell, Hobson, McPartland, Mood, Weinfeld, & York, 1966) reported that schools made little difference in student achievement. Americans, however, faithfully supported schools by allocating a substantial portion of taxes to public education and by sending their children to schools. More than 90 percent of school children population attend public schools and public education, the third largest governmental function, alone accounts for about 15 percent of the governmental expenditures (NCES, 1990; ACIR, 1990).

Why, then, have not Americans heeded the findings of the Coleman Report and stopped supporting schools? The study that explicitly examined racial and ethnic disparities in resources and achievement was bound to have significant impact when the problems of the poor in general and the black poor in particular were of primary social concern in America (Madaus, Airasian, & Kellaghan, 1980). The findings were treated as social issues rather than educational issues.

Another reason might be that, as some researchers suggested, the Coleman study had methodological flaws that impacted its claim to validity (Bowles & Levin, 1968; Smith, 1972; Hanushek & Kain, 1972). In addition, the test used in the Coleman report was developed by selecting items that maximized individual differences and, therefore, was designed to be biased against finding large differences between schools in achievement (Carver, 1975).

Perhaps the most convincing reason may be that there are too many researchers' claims that schools make a difference. Earlier, Mollenkopf and Melville (1956), Goodman (1959), and Shaycoft (1967) concluded that certain school characteristics did have a distinct influence on the achievement of students. Summers and Wolf (1977), in their article, "Do schools make a Difference?" responded affirmatively after finding that school factors did make a difference in student achievement. Murnane (1975) showed that the amount of children's learning varied according to the school in which the child was enrolled. Effective school research also shows positive influences of some school factors on student outcomes (Brookover, Beady, Flood, Schweitzer, & Wisenbaker, 1979; Rutter, Maughan, Mortimore, Ouston, & Smith, 1979; Purkey & Smith, 1983; Fullan, 1985).

During this last decade of the 20th century, we need to carefully consider emerging issues in education in order to fully equip our children for the new challenges of the 21st Century. The world appears to be getting smaller, as the image of the world as "the global village" portrays. Our students are going to be compared not only to the U.S. classmates but also to students in other countries. Whether realistic or not, we now have national goals for education for the first time in our history (The White House, 1990). Our children are to learn much more than they did in the past as well as be the first in the world in science and mathematics achievement. In short, these goals call for both higher

productivity in education and a more efficient system if America is to win the international competition.

Efficiency is a main idea of economics. Economists look for technical efficiency and allocative efficiency when productivity needs improvement (Friedman, 1984). Borrowing from economics production function models, this study searched for the ways to make the education system more efficient. Production function models can only be identified when the output is defined. The study selected student mathematics achievement, which is stated in the national education goals (The White House, 1990), as the output measure. Since mathematics achievement is considered as one of the academic areas that are most influenced by schooling and least affected by home factors (Murnane, 1975), schooling effect on student achievement can be more accurately measured using mathematics achievement.

There is no standard educational production function model that can be used to investigate the effects of inputs and processes on educational outcomes. Murnane (1987) argued that education indicators should focus exclusively upon school outputs while Oakes (1989) and Porter (1991) suggested that information on school context, i.e., school processes, should be considered. Hanushek (1979, 1986) proposed a production function that lumped all factors as inputs, such as family background inputs, peer inputs, and school inputs. Walberg (1984) categorized these inputs into three groups of aptitude, instruction, and environment.

Centra and Potter (1980) embraced all of these views as they compiled fragmented research pieces together into a whole picture, where characteristics of students, teachers, and school conditions were treated as inputs and behaviors of teachers and students were considered as processes.

Based on the review of literature, the Centra and Potter model (1980) was modified and prepared to be empirically tested at the school level. The purpose of this study was to analyze the 1990 NAEP Trial State Assessment [TSA] data and to determine what and how educational factors influence student learning outcomes as well as how important these interrelating factors are to student achievement. The study asked three research questions: (a) What are the school-related factors that are significantly related to student mathematics learning outcomes? (b) How are the school-related factors related to each other relative to student mathematics learning outcomes? (c) What are the relative contributions of the school-related factors to student mathematics learning outcomes?

Methodology

The Sample

Between February 5 and March 2, 1990, the NAEP TSA data were collected from more than 100,000 eighth-grade students in approximately 100 public schools in each of the 37 participating states, unless a state had fewer than 100 public schools with eighth-grade students, in which case all or almost all such schools participated. Approximately thirty students were selected from each school. All states, except for those with 105 schools or fewer, were stratified in the order of urbanicity and median household income variables before sampling took place.

Data Collection

In the 1990 TSA, several types of instruments were used to collect data about students, teachers, and schools. Each assessed student received a booklet containing three blocks of cognitive mathematics items, a demographic

questionnaire, and a mathematics background questionnaire. Teacher questionnaires were given to the mathematics teachers of the assessed students. A school characteristics and policies questionnaire was distributed to each participating school.

The TSA consisted of 137 items--102 multiple-choice and 35 open-ended items--that were designed to provide an extended view of students' mathematical knowledge and skills in the areas of numbers and operations; measurement; geometry; data analysis, statistics, and probability; and algebra and functions. Rather than asking each individual student to respond to all 137 cognitive mathematics items, the assessment used the focused balanced incomplete block (BIB) spiral method where all items were given to approximately the same number of students, but no student received all items.

Data Preparation

The database for the study contained information on students, teachers, and administrators from 3351 schools in 37 states that participated in the TSA. Responses to the items from student questionnaires and teacher questionnaires were aggregated at the school level in percentages. For example, for the question, "How much emphasis is given to whole number operation?", only those who responded "heavy" were counted for each school and were represented as a "percentage of students whose teachers put heavy emphasis on whole number operation." School mean scores were computed for each school by averaging students' scores in the school. The percentages and scores for each school were merged with school information obtained from the school file to create the final database for the study.

Data Analysis

Reliability Analyses

Reliability analyses were first carried out for selected questionnaire items that were believed to measure the same latent construct. When the selected items appeared to measure the scale reliably with Cronbach's alpha greater than 0.7, scores of the items were averaged to calculate the composite score for the scale.

Path Analysis

Figure 1 depicts the structural model formulated for the study which sought to identify relevant educational factors that can influence student mathematics achievement and examined interrelations among the factors relative to achievement. Five predictor constructs--student characteristics, school conditions, teacher characteristics, teacher behavior, and student behavior--were measured by eight predictor variables.

The Variables

Nine variables--eight predictor variables and one dependent variable--were included in the causal model that was formulated based on the framework of the Centra and Potter (1980).

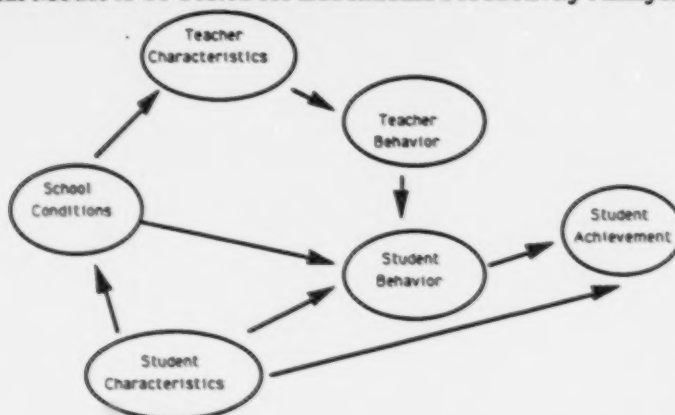
The variables are as follows:

SES (student SES background). SES was a composite variable computed for each school. It was a composite of the responses of eleven items. From the students' questionnaires, the percentages of students (a) who described themselves as white, (b) whose mothers have not finished high school*, (c) whose family received a newspaper regularly, (d) who had an encyclopedia at home, (e) who had more than 25 books at home, (f) whose family get magazines regularly, (g) whose

mother or stepmother lived at home, (h) whose father or stepfather lived at home were included. The items from the school administrators' questionnaires included (i) the percentage of families on welfare* and (j) the percentage of white students. (*Note: The values of these items were reversed, i.e., subtracted from 100, before they were analyzed.

Figure 1

Structural Model to be Tested for Educational Productivity Analysis



PERCEPT (Students' Math Perception). PERCEPT was a composite variable computed for each school that measured students' disposition toward mathematics. It was a composite of the percentages of students who agreed to questions of "I like math" and "I am good in math."

PROB (School Problems). PROB was a composite variable computed for each school that was used as a proxy for school conditions. Eleven items were the school problems of (a) student tardiness, (b) student absenteeism, (c) student cutting of classes, (d) physical conflicts among students, (e) robbery or theft, (g) vandalism of school property, (h) student use of alcohol, (i) student use of illicit drugs, (j) student possession of weapons, (k) physical abuse of teachers, and (l) verbal abuse of teachers. School administrators were asked to respond whether each of the problems mentioned above was serious, moderate, minor, or not a problem in a scale of one to four.

COURSE (math courses taken by teachers). COURSE was a measure for teacher content knowledge. It was a composite of the percentages of students whose teachers have taken one or more courses in (a) college algebra, trigonometry, elementary function; (b) number systems and numeration; (c) geometry; (d) probability/statistics; and (e) calculus.

TCHGEMPH (teaching emphasis in higher-level math). TCHGEMPH was the percentage of students whose teachers placed heavy teaching emphasis in algebra as a measure of teaching high-level math skills.

Three variables were chosen to represent student behaviors not only because they were highly correlated with achievement but also because they represent students' choices under different circumstances. Choice in school was measured by coursetaking because the choice of courses made by the student indicates directly the type of academic program the student had selected. It is recognized there are constraints on coursetaking placed by courseofferings and aptitudes. It is,

however, a choice. On the other hand, TV viewing represents the choice made by the student who has a complete control over the behavior. The student could decide on his own to watch TV or not at home. The amount of reading represents the middle ground. Students are the ones who actually do read; they could choose to read or not to read. However, the variable represents the amount of reading in school or for homework which represents, in part, what the teachers do. These three variables were placed in the order of CRSTAKE, RDG, and TV in the path analytic model according to the degree of school influence on these student behaviors.

CRSTAKE (student's course-taking behavior). CRSTAKE was measured by the percentage of students who were enrolled in advanced math classes, such as pre-algebra or algebra classes compared to regular eighth-math classes.

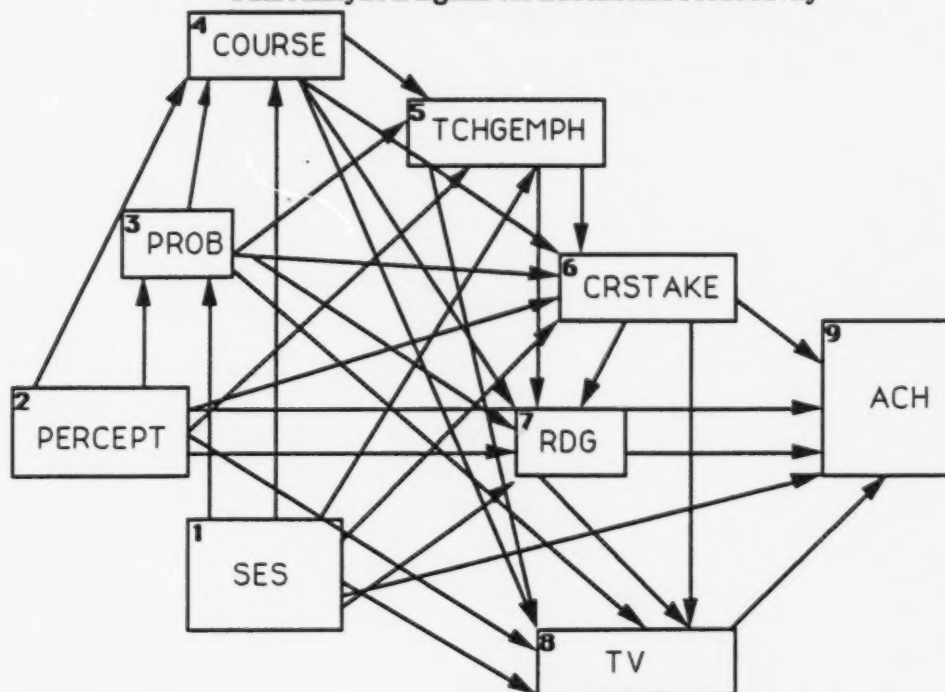
RDG (amount of reading by students). RDG was measured by the percentage of students who read more than five pages in school and for homework.

TV (amount of TV viewing). TV was measured by the percentage of students who usually watch at least three hours each day.

ACH (student achievement). ACH was an average school score for the composite scores that includes all five math content areas.

The units of the independent variables are percentages of students except PROB (school problems). The PROB variable has a scale of one to four: one for serious, two for moderate, three for minor, and four for not a problem. The unit of measurement of the ACH variable is the 1990 NAEP TSA achievement scores.

Figure 2
Path Analytic Diagram for Educational Productivity



The Path Diagram

In the path diagram shown in Figure 2, unidirectional straight arrows represent the flow of causal influences from one variable to another. Figure 2 depicts the seven path analyses carried out in the study. Each path analysis was carried out using one of the seven endogenous variables--school problems, math courses taken by teachers, heavy teaching emphasis on higher math skills, student coursetaking, amount of reading, and TV viewing time--as the dependent variable at a time.

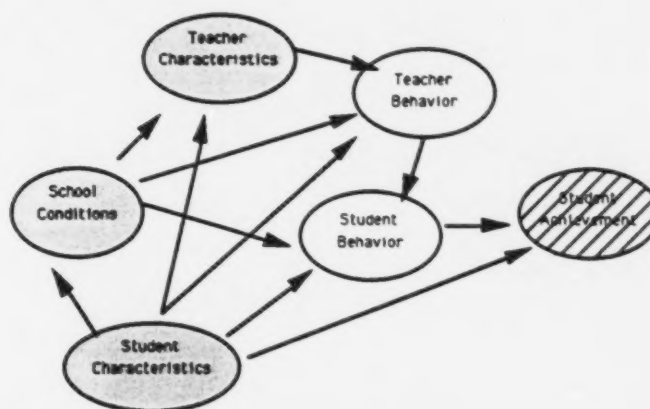
Findings

From the reliability tests, seven composite scales were computed for student SES background, math perception, school problems, and math courses taken by the teachers. Five scales resulted from highly reliable measures with Cronbach's alpha equal to or greater than 0.8.

The structural model tested for the study consisted of three big blocks: three related to characteristics, two related to behaviors, and finally achievement, as shown in Figure 3. First, the results of paths among characteristics of students, teachers, and school will be discussed. Second, the results of the analyses of the paths to behaviors will be presented. Third, the paths from student characteristics and student behaviors to achievement will be discussed. Finally, the direct paths leading to achievement will be discussed in terms of overall impacts of all these constructs on achievement.

Figure 3

Structural Model of Interrelational Educational Constructs Influencing Student Learning Outcomes



Paths among Characteristics

Effects on School Conditions

As Brookover et al. (1979) found, the results shown in Figure 4 indicate that student characteristics were highly related to school conditions. When "school conditions" was measured by the degree of school problems, the schools which consisted of students from higher SES background appeared to have fewer school problems.

While statistically significant, math perception had less influence on the level of school problems ($p = 0.09$) than student SES background. The positive path indicated that schools with fewer problems seemed to have greater percentages of students who liked math or felt that they were good in math.

Figure 4

**Effects on School Conditions
Measured by PROB (School Problems)**

Variables	Parameter Estimate	Standardized Estimate	Probability > t
SES	0.013	0.29	0.0001
PERCEPT	0.004	0.09	0.0001
INTERCEPT	2.119		0.0001

Effects on Teacher Characteristics

As proposed by Porter (1991), the paths from both school conditions and student characteristics to teacher characteristics were found to be statistically significant. School conditions appeared to be a very important determiner in attracting quality math teachers. Figure 5 depicts the results of the analysis for the paths leading to teacher characteristics. The positive path from PROB (school problems) to COURSE (math courses taken by teachers) indicated that greater percentages of students were taught by the teachers who had taken more mathematics courses were in schools with fewer problems. Schools with fewer problems were more attractive to teachers who had more math content knowledge than schools with serious problems.

Figure 5

**Effects on Teacher Characteristics
Measured by COURSE (Math Courses Taken by Teachers)**

Construct	Variable	Parameter Estimate	Standardized Estimate	Probability > t
Student Characteristics	SES	0.12	0.06	0.003
	PERCEPT	0.09	0.05	0.014
School Conditions	PROB	5.16	0.11	0.001
	INTERCEPT	49.78		0.001

While student characteristics had a smaller direct influence on teacher characteristics than school conditions, the positive paths from SES (student SES background) and PERCEPT (student math perceptions) indicated that more teachers with math content knowledge appeared to be teaching the students with high math perceptions ($p = 0.05$) in schools with more students from higher SES background ($p = 0.06$). Even though the direct effect of student SES background on teacher characteristics was smaller than that of school conditions, its total effect was relatively large when the indirect effect through

school conditions was included (total effect = direct effect + indirect effect = $0.06 + 0.29 \times 0.11 = 0.06 + 0.03 = 0.09$).

Paths from Characteristics to Behaviors

Influences on teacher behavior and student behaviors were examined in the study. Teacher behavior was measured by teaching emphasis on higher level math skills in classrooms. Student behavior was represented by three different measures: coursetaking, reading, and TV viewing. Effects on each of these three behaviors will be discussed separately.

Effects on Teacher Behavior

Figure 6 summarizes the results of the effects on teacher behavior. The largest impact on teacher behavior seemed to come from teacher characteristics. What teachers do in class seemed to be determined by how knowledgeable they are in the content they teach. The COURSE variable (math courses taken by teachers) had the strongest direct effect on TCHGEMPH (heavy emphasis on higher math skills).

Figure 6

Effects on Teacher Behavior
Measured by TCHGEMPH (Teaching Emphasis in High Math Skills)

Construct	Variable	Parameter Estimate	Standardized Estimate	Probability > t
Student Background	SES	0.19	0.06	0.004
	PERCEPT	0.229	0.08	0.001
School Conditions	PROB	7.38	0.11	0.001
Teacher Characteristics	COURSE	0.27	0.18	0.001
	INTERCEPT	-25.26		0.001

The results also indicate that school conditions had some impacts on teacher behavior. It might be that the schools with less problem were able to emphasize more on academic excellence. In his processes-indicators model, Porter (1991) described the directional influence from organizational characteristics of school, which included school quality, to instructional characteristics of schooling, which included teaching quality.

Effects on Student Behaviors

Three measures of student behavior were examined--coursetaking, reading, and TV viewing.

Effects on coursetaking. As shown in Figure 7, teacher behavior had the largest impact on student behavior in school ($p65 = 0.23$). Coursetaking was the measure of student behavior in school. Lee and Bryk (1988) found that greater academic coursetaking resulted, in part, from the adults encouraging students to pursue academics.

Another statistically significant influence came from student SES background. Garet and DeLany (1988) described student coursetaking as students being matched into positions in the curriculum according to their background characteristics.

Figure 7

Effects on Student Behavior
Measured by CRSTAKE (Coursetaking in Advanced Math Classes)

Construct	Variable	Parameter Estimate	Standardized Estimate	Probability > t
Student Characteristics	SES	0.40	0.14	0.001
	PERCEPT	-0.08	-0.03	0.099
School Conditions	PROB	2.21	0.04	0.070
Teacher Characteristics	COURSE	0.04	0.03	0.178
Teacher Behavior	TCHGEMPH	0.20	0.23	0.001
	INTERCEPT	-1.48		0.794

Figure 8

Effects on Student Behavior
Measured by RDG (Amount of Reading in School or for Homework)

Construct	Variable	Parameter Estimate	Standardized Estimate	Probability > t
Student Characteristics	SES	0.31	0.20	0.001
	PERCEPT	0.15	0.11	0.001
School Conditions	PROB	3.53	0.11	0.001
Teacher Characteristics	COURSE	0.003	0.01	0.816
Teacher Behavior	TCHGEMPH	0.06	0.13	0.001
Student Behavior	CRSTAKE	0.01	0.02	0.453
	INTERCEPT	18.48		0.001

Effects on reading. Figure 8 summarizes the results of the effects on reading. This behavior denoted student behavior in both settings of school and home. It was expected

that reading student behavior was to have less influence from school conditions and more from student characteristics than coursetaking student behavior. The results indicate, as expected, that this kind of student behavior was influenced significantly by both student characteristics and teacher behavior.

Centra and Potter (1980) proposed that student behavior would be directly influenced by student characteristics, school conditions, and teacher behavior. The results of the data analysis shown in Figure 8 seemed to be consistent with their hypothesis. The paths from student SES background, math perception, school problems, and teaching emphasis all showed sizable positive impacts on student reading behavior ($p_{71} = 0.20$, $p_{72} = 0.11$, $p_{73} = 0.11$, $p_{75} = 0.13$, respectively).

Effects on TV viewing. TV viewing student behavior measured the student's own choice in out-of-school settings. It was, therefore, expected that comparatively large influence would be found from student characteristics than from teacher behavior. As shown in Figure 9, student SES had the greatest impact on student's TV viewing behavior. Keith et al. (1986) found the similar result from their analysis of HS&B longitudinal study. They found that family background and intellectual ability had the strongest effect on TV time.

The strong relation between reading behavior and TV viewing behavior might be due to the fact that both of these behaviors were strongly influenced by student SES background.

Figure 9

Effects on Student Behavior
Measured by TV (Excessive TV Viewing Time)

Construct	Variable	Parameter Estimate	Standardized Estimate	Probability > t
Student Characteristics	SES	-0.55	-0.34	0.001
	PERCEPT	-0.07	-0.05	0.011
School Conditions	PROB	-1.58	-0.05	0.017
Teacher Characteristics	COURSE	0.02	0.03	0.121
Teacher Behavior	TCHGEMPH	-0.02	-0.04	0.051
Student Behavior	CRSTAKE	-0.05	-0.08	0.001
	RDG	-0.17	-0.17	0.001
	INTERCEPT	126.06		0.001

Effects on Achievement

The paths from student characteristics and student behaviors to achievement were all statistically significant as shown in Figure 10. As was proposed by Centra and Potter (1980), student characteristics and student behaviors were highly related to student achievement. Student SES background seemed to have the largest impact on achievement ($p91 = 0.53$) followed by excessive TV viewing time ($p98 = -0.28$). In addition, school-related student behaviors, such as coursetaking and reading in school and for homework also had significant influences on achievement ($p96 = 0.11$, $p97 = 0.11$, respectively).

The positive path from coursetaking student behavior to achievement seemed to be in line with other studies that found significant relations between coursetakings and achievement (Lee & Bryk, 1988; Chubb, 1988). Stallings and Kaskowitz (1974) also found a positive relationship between opportunity to learn academic content and achievement.

The positive relationship between reading and achievement was reported by Walberg (1984) who found some large effects for reading training. The result shown in Figure 10 indicated that reading student behavior had significant positive impact on student achievement.

The result also indicated adverse negative effects of excessive TV viewing on student achievement as reported by earlier research studies (Williams et al, 1982; Keith et al., 1986).

Figure 10

Effects on Achievement

Construct	Variable	Parameter Estimate	Standardized Estimate	Probability > t
Student Characteristics	SES	1.09	0.53	0.001
	PERCEPT	0.13	0.07	0.001
Student Behavior	CRSTAKE	0.08	0.11	0.001
	RDG	0.14	0.11	0.001
	TV	-0.36	-0.28	0.001
	INTERCEPT	187.5		0.001

Overall Impacts on Achievement

When achievement was examined as a function of the eight predictors--student background, math perception, school problems, teacher education background, teaching emphasis, coursetaking, reading, homework, and TV time--the results indicated that these predictors appeared to explain much of the variance in student achievement ($R^2 = 0.67$).

All eight predictors were found to be statistically significantly related to student achievement.

The results shown in Figure 11 suggest that student characteristics and student behavior seemed to be highly related to student achievement. Most of the variables that were highly related to achievement can be manipulated or controlled by school administrators and teachers. While student SES background and TV viewing student behavior cannot be changed by school administrators and teachers directly, other matters, such as teaching high math skills, organizing curriculum to reflect academic emphasis, or designing lessons to encourage students to read more, can be controlled by school educators.

Figure 11
Effects on ACH (Simple Multiple Regression)

Construct	Variable	Parameter Estimate	Standardized Estimate	Probability > t
Student Characteristics	SES	1.07	0.53	0.001
	PERCEPT	0.14	0.07	0.001
School Conditions	PROB	4.62	0.11	0.001
Teacher Characteristics	COURSE	0.04	0.04	0.001
Teacher Behavior	TCHGEMPH	0.05	0.08	0.001
Student Behavior	CRSTAKE	0.07	0.10	0.001
	RDG	0.13	0.10	0.001
	TV	-0.32	-0.26	0.001
	INTERCEPT	166.88		0.001

While the amount of time allocated to TV viewing seemed to be a decision solely made by the students, teachers can also affect it indirectly by encouraging students to read more at home or by motivating them to work on some interesting projects at home. It is not being suggested to encourage students to quit viewing TV completely, but motivating them to stay away from excess TV viewing by providing them with some constructive alternatives they can choose to do at home.

Summary and Discussion

The model proposed by Centra and Potter (1980) seemed to be a good starting point for investigation of educational productivity within the context of schooling. This study used a modified version of the Centra and Potter model to identify paths among important educational constructs using path analysis and the 1990 NAEP TSA data. In line with the

Centra and Potter model (1980), three categories of paths were identified as shown in Figure 12: (a) paths among characteristics of students, school conditions, and teachers; (b) paths to behaviors of teachers and students; and (c) paths to achievement.

For the paths among characteristics, student characteristics seemed to have a large impact on school conditions, which in turn, had strong influences on teacher characteristics. In addition to this mediating effect through school conditions, student characteristics appeared to have modest direct effects on teacher characteristics as well.

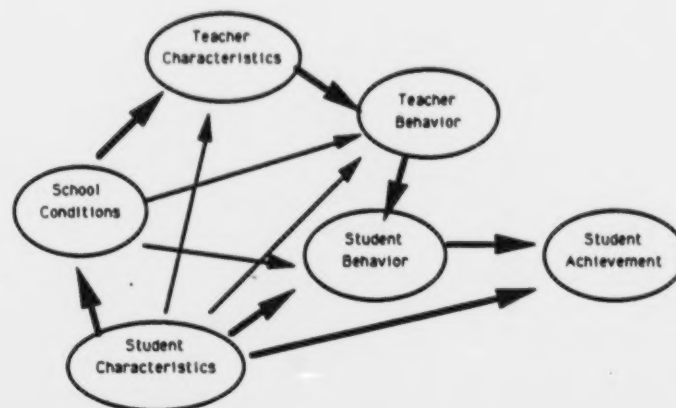
Teacher characteristics had the greatest influence on teacher behavior while sizable effects were also evident from school conditions and student characteristics.

The major sources of influences on student behaviors were teacher behavior and student characteristics. When student behavior was school-related, teacher behavior had the greatest impact on student behavior and student characteristics had some modest impact. As student behavior progressed toward home-related behavior, influences from student characteristics, such as student SES background, gradually became greater. As influences from student characteristics increased, influences from school conditions on student behavior also became evident.

As Centra and Potter explained, the constructs that were closely located to each other in the model were more highly related. The underlying implication of the model was, then, constructs located closer to achievement would have the greater impacts than constructs located further away from achievement. Accordingly, student characteristics and student behavior would have greater influences than teacher characteristics, teacher behavior, or school conditions.

Figure 12

Significant Paths from Educational Constructs to Achievement
Identified from the Study



The results of the study seemed to confirm that student characteristics and student behavior did have large impacts on student achievement. While students come to school with their own student characteristics, how school educators respond to influence student behavior--the other construct that had large impacts on achievement--could make a difference in school. The study findings suggest that school educators can influence student behavior through teacher behavior and school conditions.

The results of the study indicate that there are important school factors that can be changed by school administrators and teachers to improve student achievement. Some of the significant paths to student achievement were identified as the areas of schooling processes that can be examined to improve education productivity. Rather than focusing on the student behavior that schools cannot control, such as excessive TV viewing, school efforts should be geared to the student behaviors that can be modified by school policies or teaching strategies. Encouraging students to read more or designing lessons to include more reading for students is one strategy. Academic emphasis of the school through curriculum organization and emphasis on higher skills in classrooms can have large impacts on student's coursetaking behavior.

Teachers seem to hold the key in this educational process. The quality of teachers, therefore, should be evaluated carefully. In order for teachers to teach higher math skills, they first need to be equipped with content knowledge.

In summary, the study findings seem to shed light on efforts to search for higher education productivity. The results of the study indicate that, as was found in new research findings since the mid-1980s, teacher content knowledge and academic emphasis were important factors through which schools can make a difference in student achievement (Bryk, Lee, & Smith, 1990; Lee & Bryk, 1988; 1989; Garet & DeLany, 1988). In most school systems, teaching experience and university credit units are used as proxy measures for teaching skills and knowledge. The study findings suggest that student mathematics achievement can be positively impacted by taking academic courses and teachers' placing academic emphasis on higher math skills in classrooms. Schools need to design the curriculum organization to encourage higher student enrollment in academic core courses and teachers must possess content knowledge to be able to emphasize academic skills in classrooms.

Recommendations

Education Practices

The results of the study support the importance of schooling processes to improve student learning outcomes. The impact of student characteristics on achievement is a factor that schools have no control over since the input--student characteristics--is given to school. Rather than focusing on the factor that schools do not have any control over, the efforts should be geared toward the factor that can be changed by school educators--student behavior.

Instead of debating whether education production functions exist or not, research focus should be turned toward identifying important input and process variables. Process variables on teacher behavior and student behavior should be the primary task for future education productivity research. Significant variables must be identified and the methods to collect the data on the variables reliably and validly need to be developed.

These process variables describe what goes on in classrooms. As students spend much of their school time in classrooms where teachers provide them with learning opportunities, classroom-level analysis may reveal the actual learning production process. The findings of the study suggest that engaging students in content-emphasized instruction provided by teachers who were equipped with content knowledge is one way to improve education productivity. A more efficient education system may result by allocating resources to (a) acquire content-knowledgeable teachers, (b) train teachers to design lessons to encourage students to read more and to refrain from excessive TV viewing, and (c) restructure curriculum organization and academic requirements and expectations to emphasize desired student behavior.

Further Research

Further research is recommended to expand the structural models to identify more process variables as well as interrelations among them. The process variables identified by past research need further investigation on identifying the nature of the processes that are associated with the kind of achievement outcomes needed for the 21st Century. For example, the process variable of instructional time needs to be probed to identify the characteristics of teacher behavior, such as whether teachers are concentrating on drills and practices of basic skills or placing emphasis on higher academic skills.

Interrelations among process variables that measure teacher behaviors and student behaviors need further research. For instance, does teacher behavior affect student behavior or is teacher behavior affected by student behavior? Even among the process variables that measure student behavior, are there any directional influences?

The NAEP TSA was designed to make interstate comparisons possible. Earlier, discriminant function analysis of the 1990 NAEP TSA data indicated that there were significant differences in inputs and processes between high- and low-performing states (Odden & Kim, 1991). The path analyses used in the study can be applied to individual states to determine whether the same results are obtained from all states. If different results occur, then high-performing states and low-performing states can be categorized into two groups to explore the differences between the two groups.

Higherarchical Linear Modeling (HLM) approach can also be used in replicating the analyses carried out in this study for individual states to identify whether state policies and state conditions affect the pattern across 50 separate state education systems in the United States.

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California State University, Los Angeles

TO: Distribution IV & V

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FROM: Bev Mitchum, Telecommunications Director
IRM Operations

COPIES: P. Quan

SUBJECT: 1992-93 Telecommunications Directory

Attached are the revisions of the Telecommunications Directory for your information and filing. As you may recall, we no longer issue a complete yearly directory. Updates are issued for each section as the number of changes dictate.

Each section is identified by a corresponding letter of the alphabet as shown below:

A	Emergency Information	F	Billing Reports and Information
B	General Information	G	Forms
C	IRM Services and Information	H	News and Bulletins
D	Alphabetical Directory	I	Index
E	Department Directory		

Please make the following substitutions:

<u>TITLE</u>	<u>PAGE</u>	<u>REVISION DATE</u>
Table of Contents	i	01/04/93
Emergency	A3 - A5	12/31/92
CSU Campuses	B1	02/12/93
Administration	B2 - B3	02/16/93
School and Department/Division/Program Offices	B4 - B5	02/17/93
Directory of Bureaus, Centers and Institutes	B6	02/22/93
CSLA Services and Activities	B7 - B11	02/22/93
Mail Codes and Extension Quick Reference	B12 - B15	02/22/93
Campus Facsimile Machines	B16	12/31/92
IRM Operations Telephone Numbers	C1	12/02/92
Telecommunications Department Representatives	C2 - C3	12/02/92
Personal Telephone Calls	C4	12/31/92
Voice Mail purchase Requisitions	C15	12/02/92
VMX Quick Reference	C16	12/31/92
Telephone and Voice Mail User Training	C18	12/02/92
INX Purchase Requisition	C19	12/02/92
Calling Card Request	C20	12/31/92
Voice Mail Broadcast Request	C21	12/02/92
DB2 SIS Plus Reference	C22 C26	12/14/92
Modem Pool Access Instructions	C25	12/14/92
Telecommunication Directory Changes	C23	12/31/92
Alphabetical - Faculty and Staff	D1 - D40	02/15/93
Department Directory	E1 - E20	02/15/93
Billing Reports and Information	F1 - F6	12/31/92
Forms	G1 - G7	10/02/92
Index	I1 - I4	01/04/93